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Aircraft Stability and Control

Time: 3 hrs.

Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Missing data if any may suitably be assumed.*

PART – A

1 a. Explain the terms of equilibrium conditions, static stability, longitudinal static stability and stability criteria with relevant equations and graphs. **(10 Marks)**

  b. Derive expression for wing contribution $\left(\dfrac{dC_m}{dC_L}\right)_\omega$ for the longitudinal static stability of an airplane and discuss the significance of C.G. position with respect to the wing aerodynamic center. **(10 Marks)**

2 a. Write the expression for stick-fixed neutral point and discuss the C.G. range on the aircraft. **(10 Marks)**

  b. Explain longitudinal control and derive the equation for elevator angle versus equilibrium lift coefficient. **(10 Marks)**

3 a. Briefly explain Hinge moment parameters and trim tabs. **(10 Marks)**
  b. Derive an expression for stick-free neutral point with necessary graphs and compare it with stick-fixed neutral point. **(10 Marks)**

4 a. Define static directional stability of an airplane and the criteria with the relevant sketches and expressions. **(06 Marks)**
  b. Explain the following terms:
    i) Adverse Yaw
    ii) Cross-wind landings.
    iii) Asymmetric power condition.
    iv) Spin recovery **(08 Marks)**
  c. Explain what is meant by 'Rudder lock' and the Dorsal fin. **(06 Marks)**

PART – B

5 a. Obtain the relation for roll control power $C_{l_{\delta a}}$. **(08 Marks)**
  b. Explain the effect of Wing Sweep, flaps and power on dihedral effect. **(12 Marks)**

6 a. Derive Rigid body equations of motion. **(12 Marks)**
  b. Briefly explain gravitational and thrust forces. **(08 Marks)**

7 a. Describe the aerodynamic response to Aileron with adverse yaw effect with required equation and graphs. **(10 Marks)**
  b. Derive an expression for change in forward velocity. **(10 Marks)**

8 Write short notes on the following:
  a. Wing rock.
  b. Roll control reversal.
  c. Spiral approximation.
  d. Dutch roll approximation. **(20 Marks)**

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